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## SWEET CORN IN JALISCO

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Any careful inquiry into the origin of a cultivated plant presents a twofold problem: the origin of the plant and the origin of its use. These two lines of inquiry yield two different kinds of evidence whose relative importance may vary greatly from crop to crop. It may even vary for different kinds of the same crop, as for example, dent corn and sweet corn, two characteristic forms of *Zea Mays*.<sup>1</sup> For dent corn the genetical situation is complex; the cultural one is simple.<sup>2</sup> For sweet corn, the opposite is true. Therefore, genetical evidence is more decisive in studying the origin of the former, cultural evidence in studying the latter.

As Erwin ('31, '42) has pointed out, the origin of sweet corn presents no particular problem genetically. Though there is more than one allelomorph of the gene for sweet and though in some stocks of maize a genetically sweet kernel will give little outward indication of that fact, the difference between sweet and non-sweet is a single gene difference. Sweet corn, therefore, can arise spontaneously from any ordinary maize; it is possible and even probable that sweet corns may have originated in various places and at various times.

Culturally, however, the story is more complex. While the change is a simple one genetically, it presents the maize grower with a product quite different from that which he had previously. Unlike the change from flinty to floury or from

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<sup>1</sup> The word "corn" is used throughout this paper to refer to maize (*Zea Mays*). While the latter term customarily is used in scientific papers because of its greater precision, its adoption here would result in the unnatural compound "sweet maize", a term which never is heard in the regions where "sweet corn" is grown.

<sup>2</sup> Dents differ from non-dents by a very large number of genes (Hayes, '12). The genetical story is a complicated one, but once it is understood we shall have critical evidence concerning the origin of dent corns from their presumably undented ancestors. A slightly dented variety will differ but little from flour corn in composition or texture; a strongly dented kernel will be almost like a flint. Among the various varieties of corn grown by the Indians of the American Southwest the undented and "semi-dented" varieties often are used for the same purposes, and many of the varieties show a mixture of undented and slightly dented ears. Accordingly, cultural data will have relatively little bearing on the history of the dent corns.



non-dent to dent, this mutation produces a kernel which for most purposes is decidedly inferior to that of non-sweet maize. At the same time, it produces a kernel which can be used in various new ways when once its capabilities are recognized.

Sweet corn is therefore a peculiar product which usually must be, and frequently is, used in special ways. Although the cultural evidence is somewhat diverse, eventually it should cast light on the early history or histories of sweet corn as a cultivated crop. The present paper does not attempt to discuss this general problem; it merely presents as fully as possible the evidence concerning the morphology, the cytology, the distribution, and the uses of sweet corn in Jalisco, Mexico. When similar information is available from other critical areas, it should then be possible to attack the larger problem.

#### MORPHOLOGY



Fig. 1. Longitudinal section of a kernel of Jalisco sweet corn. Stippled area indicates embryo. In endosperm, black indicates sugary and white indicates starchy.

A detailed summary of ear, cob, and kernel characters in our collections is presented in table 1 (see Anderson and Cutler, '42), and typical ears are illustrated in pl. 4. It will be seen that the grains, while similar in general appearance to commercial varieties of sweet corn, are characteristically not quite so shrunken. This impression is confirmed when the kernels are examined histologically. The endosperm is not completely sugary but has starch stored at the base as shown in fig. 1. It is therefore unlike the sweet corns of the United States, which ordinarily have no such basal starch zone. Mangelsdorf and Reeves have given a preliminary report ('39, p. 257) on these Mexican sweet corns. They are apparently due to another allelomorph of the gene for sweet and are further affected by a modifying gene in the tenth chromosome. The tests necessary to work out the exact genetic constitution of Jalisco sweet corn would be difficult to make in the United States since these varieties have a very long growing season.

The color of the dried kernels varies from a bright orange-yellow to deep red. The endosperm is yellow, and the various shades of orange and red result from varying amounts of color in the pericarp. We have neither seen nor heard of a white sweet corn in Jalisco although this color is common among flour corns, dent corns, and popcorns in that area. Sweet corn sometimes is said to be "*negro*", but this probably refers to the dark red ears; a dark red flint from Unión de Tula is called "*maiz negro*" merely because it is dark-colored when cooked.



TABLE I

SUMMARY OF EAR, COB, AND KERNEL CHARACTERS IN JALISCAN SWEET CORN

("s" indicates that a character is strongly developed; "w" that it is present but not extreme. All measurements in centimeters.)

Locality	Ear length	Mid-ear width	Shank diameter	Row number	Row width	Kernel thickness	Husk striation	Base compression	Color
Unión de Tula	14	5.2	1.4	20	.9	.4	w	s	Red
Unión de Tula	16	4.6	1.6	16	.9	.4	w	s	Light orange
C. Guzmán	13	5.1	1.9	16	1.0	.5	s	s	Red
C. Guzmán	16	5.7	1.7	20	.9	.4	w	s	Dark orange
Ameca	20	4.9	2.2	16	1.0	.4	w	s	Dark red
Ameca	19	4.7	1.8	20	.8	.5	s	s	Orange
Ameca	18	4.3	1.8	12	1.2	.5	s	s	Yellow

Ten to fifteen plants were grown from each of the three ears collected at Las Canoas, near El Chante, Autlán. They were planted at the Blandy Experimental Farm of the University of Virginia, at Boyce, Virginia, in early May and did not flower until the middle of September. In long season, as well as in other ways, they were very similar to the characteristic small-kernelled flints or popcorns of Jalisco which bear a general resemblance to most of the "hot country" varieties of maize from the Colorado River to the deserts of Chile. Detailed measurements are presented in table II. In general, the plants were tall, slender, and tough. The internode diagram of a typical plant is illustrated in fig. 2. Tillers were frequent and often numerous (see table II), and the tillers were morphologically so like the main stalk that by the time the plants had begun to tassel it was often difficult to tell which was the primary shoot and which were secondaries.<sup>3</sup> The leaves were slender and tough and were undamaged in windstorms which played havoc with collections from Guatemala and from Michoacán.

TABLE II

SUMMARY OF PLANT AND TASSEL CHARACTERS FOR 3 EAR-TO-ROW TESTS OF JALISCAN SWEET CORN

Plant No.	Tiller Number			Number of tassel branches	Glume length in cm.	% condensed internodes	% sub-sessile spikelets
	Min.	Ave.	Max.				
24a	1	4	5	27	1.2	10	0
24b	0	2	3	31	1.1	0	0
24c	0	2	3	21	1.1	30	0

<sup>3</sup> It must be noted that several traits exhibited in the experimental plantings are not characteristic of sweet corn when it is grown locally in Jalisco. In the first place, the remarkable tillering qualities above described are abnormal. In Jalisco, sweet corn, and other maize varieties as well, ordinarily produces a single stalk; for this reason several kernels are planted together. In the second place, the rare secondary stalks which appear are easily distinguishable from the primary shoot since they remain somewhat stunted. In the third place, in Jalisco, sweet corn does not require an excessively long season but ripens coincidentally with most other types of maize; green ears are available approximately three months after planting. However, dent corn from Michoacán did not tiller when grown in Virginia, nor did it require such a long growing season.



The ears characteristically were shorter, thicker, and more rounded than those of other Jaliscan maize. They bulged in the middle rather than tapering sharply and evenly like most Mexican maize. Since cob shape depends upon a very large number of genes, it is one of the best criteria of relationship. It is therefore significant that Jaliscan sweet corns tend very strongly to have a cob shape which is different not only from other Jaliscan maize but also from most other Mexican

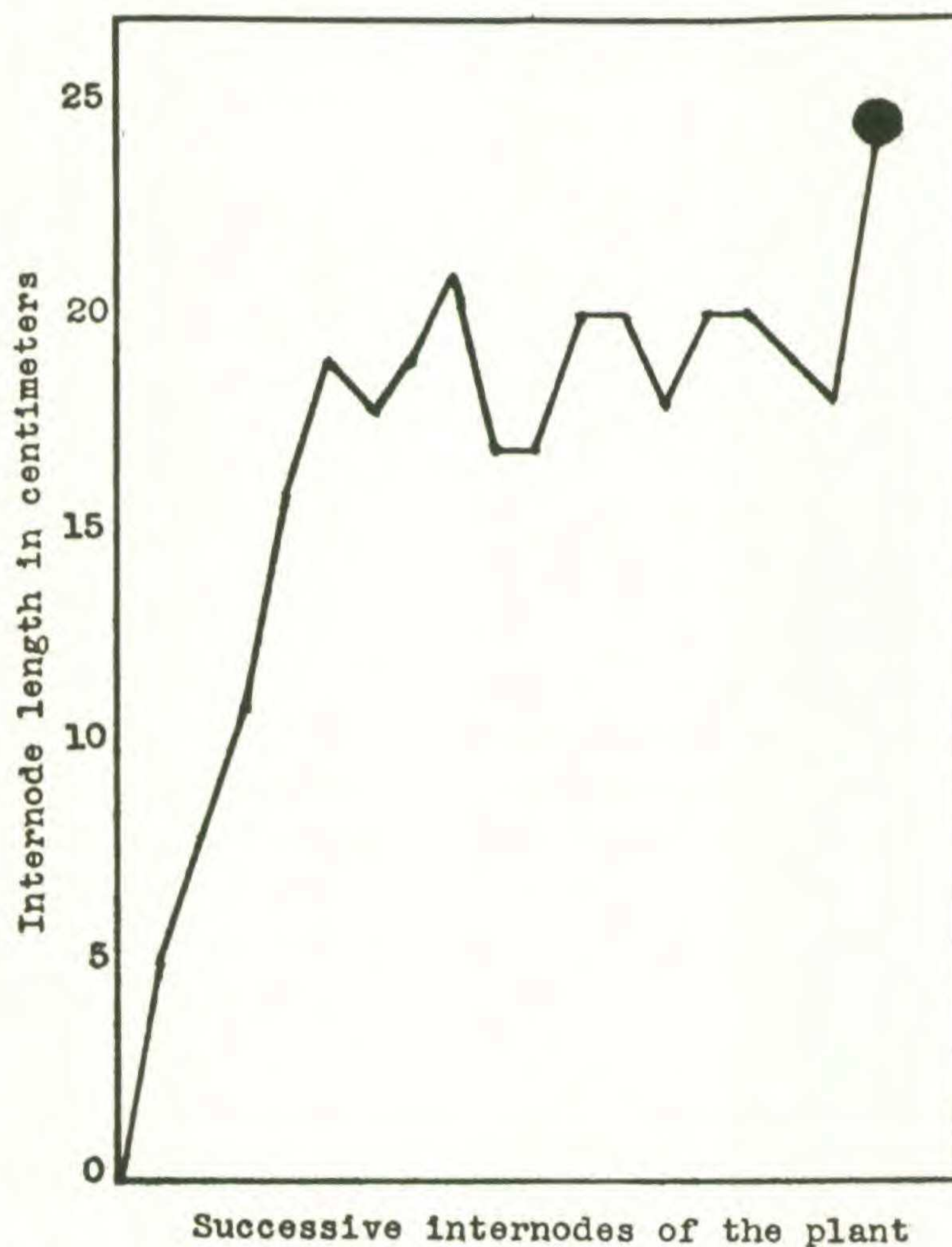


Fig. 2. Internode diagram of a typical plant of Jaliscan sweet corn as grown at Blandy Farm. Circle represents the tassel.

maize. It is, however, a shape which is common in parts of South America and which also occurs in Guatemala. In this connection it is interesting that when the kernel color pattern is revealed by contamination with starchy corn (pericarp colors are difficult to distinguish on a background of sweet endosperm) it is one which is common in Guatemala but very rare in most of Mexico, being deep red at the base and fading towards the top so that the yellow endosperm shows through.

The leaves were practically glabrous, with only a few long scattered hairs at the top of the sheath, and both leaves and stems were a bright, shiny green, with only a trace of anthocyanin pigment. By the time the plants were well developed they were so slender, green, and tough, and there were so many tillers, that they



resembled a bamboo thicket rather than a field of North American sweet corn. The tassels developed so late in the season that their development was probably somewhat abnormal. However, they seemed to be similar to most other Jaliscan maize in having large open tassels with many widely separated branches and large coarse glumes. Anthers and silks were uniformly green.

*Conclusions from morphological data.*—In general, Jaliscan sweet corn is similar to the other maize of that region and is particularly close to the slender, small-grained popcorns which apparently have been there for a very long time. Its most important differences are the larger, broader, more rounded ear and the peculiar red and yellow color. The cob size and shape are comparatively uniform from collection to collection, and there is less color variation than among other kinds of Jaliscan maize. Its uniformity and its slight but constant cob differences suggested that Jaliscan sweet corn may have originated elsewhere. In any case, it appears either to have been extensively mixed with Jaliscan maize or to have originated from a closely related stock.

#### CYTOLOGY

Pachytene acetocarmine smears were made from one plant at the Blandy Experimental Farm. The data are summarized in table III. While they will be much more significant when our knowledge of knob number and distribution in various races of corn is more complete, they already confirm the above conclusions derived from pure morphology. In general, the distribution of the knobs and their number and size are like those of other Jaliscan maize, the two small sub-median knobs on the sixth chromosome and the very large terminal knob on the ninth being particularly characteristic.

TABLE III  
KNOB NUMBER AND DISTRIBUTION IN JALISCAN SWEET CORN  
("s" indicates a small knob, "T" a terminal knob.)

Chromosome Number	1	2	3	4	5	6	7	8	9	10
Average for Jalisco (non-sweet)	0	1	1	1	1	3 (2s)	1	0	T	0
No. 25	0	1	1s	1s	1	3 (2s)	1	0	T	0

#### DISTRIBUTION AND USES

Sweet corn, or *maiz dulce*, as it is known in Mexico, is general throughout the state of Jalisco, although it is not grown on a large scale. It has a wide altitudinal zonation, from La Huerta, in the Purificación, to El Jazmín, and throughout the Los Altos zone.<sup>4</sup> No information is available from the Pacific seaboard (Puerto

<sup>4</sup> Actual elevations are not readily ascertainable. The 1926 Scanlon map, published by the Secretaría de Agricultura y Fomento, indicates that La Huerta has an approximate elevation of 500 m., whereas the Los Altos district ranges from 1500 to 2000 m.



Vallarta, Tomatlán, Sihuatlán, etc.), but it may be predicted confidently that sweet corn will be found in this coastal stretch. In fact, of the areas of Jalisco which we know, only the upland, almost sub-alpine, district of Tapalpa is said definitely to lack *maiz dulce*. The latter evidently has a considerable tolerance to cold since it is grown in the more sheltered spots about El Jazmín, on the north flank of the Volcán de Colima, where maize and beans alike require six months to mature.

Collections have been made in the following areas: Ameca; Las Canoas, El Chante, Autlán; Tuxcacuesco; Telcampana, near San Gabriel; Sayula; Ciudad Guzmán (Zapotlán); Tuxpan; Tenamaxtlán; Mascota; Talpa; Ayutla; and Teocaltiche. In addition, although we have no samples, informants definitely report sweet corn from: La Huerta, Purificación; Zapotitlán; El Jazmín; San Pedro Tlaquepaque; Jalostotitlán; San Juan de los Lagos; Lagos de Moreno; and Encarnación.

In Jalisco sweet corn is not a commercial crop and is grown chiefly for home consumption. It is offered for sale only in small quantities and, as far as we know, invariably in the form of confections (see below). It is essentially a product of the *ranchos* and small *pueblos*; if not actually scorned by city people, it is regarded by them as a somewhat rustic food. Ordinarily sweet corn is planted in the *milpas* as a summer (*temporal*) crop, although there is no physical reason why it should not be grown in irrigated plots or in gardens. The feeling seems to be that it is not of sufficient importance to warrant the bother of irrigating.

The cultural data presented below apply primarily to western Jalisco, specifically to the Ameca-Autlán-Tuxcacuesco districts. A few supplementary data suggest that as regards maize utilization western Jalisco may differ somewhat from the Los Altos zone, the great expanse of high-steppe country which extends from Lake Chapala northeastward. From personal observation and from the interrogation of a limited number of informants from diverse parts of the state, the general *maiz dulce* picture appears to be as presented below.

The potential uses of sweet corn are restricted and overlap relatively little with those of the less specialized forms of maize. First and foremost, it must be made clear that *maiz dulce* is not considered satisfactory for *nixtamal* (the dried, mature maize kernel, which is steeped with lime in hot water and when softened is ground on the *metate* to produce the *masa* for making *tortillas*). However, in certain areas (Sayula, Tuxpan, and apparently through much of the Los Altos zone), sweet corn is used for *atole*, a sort of maize gruel.<sup>5</sup> This is not a general practice in western Jalisco.

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<sup>5</sup> Several types of *atole* are known in Jalisco, and our data do not specify which of these may be made from sweet corn. Probably it is not the *atole* which has a *nixtamal* base, since it is said specifically that sweet corn is not suitable for the preparation of this near-hominy. Presumably the *atole* in question is made of maize which is boiled (without lime), ground, strained, and served without further ado in a semi-liquid state.



Occasionally, green ears of sweet corn are boiled or roasted, but these are not considered particularly tasty since the maize is gummy and sticks between the teeth. However, in certain areas of Los Altos (Encarnación and Jalostotitlán; *not* in Lagos de Moreno or in San Juan de los Lagos), sweet corn is served as *esquite*;<sup>6</sup> in western Jalisco the latter usually is made with white corn.

Aside from the above-noted uses, which are not general, the culinary functions of *maiz dulce* are pretty effectively confined to two special confections: *pinole* and *ponteduro*.

*Pinole*<sup>7</sup> is by no means a standard item of diet but is prepared "*por gusto*", when one has a desire for it. Its function is essentially that of a confection. Although of no dietary significance, *pinole* evidently is well established in the local culture, as witnessed by two common proverbs: "No se puede chiflar y comer pinole" (one can't whistle and eat *pinole*) and "El que tiene más saliva come más pinole" (he who has the most saliva eats the most *pinole*). Throughout western Jalisco *pinole* is probably the most common dish made of *maiz dulce*. In the Los Altos zone, specifically in Encarnación and Jalostotitlán, *maiz dulce* similarly is made into *pinole*. However, in two other pueblos of Los Altos (Lagos de Moreno and San Juan de los Lagos), it is said that *pinole* is made exclusively of *maiz negro*. The same is true of the Jalisco-Zacatecas border country (Teocaltiche, Nochistlán), where it is said that sweet corn is too oily for successful *pinole*.

*Ponteduro*<sup>8</sup> is the second major dish prepared with *maiz dulce*; it is made throughout Jalisco, wherever sweet corn occurs. A variant of *ponteduro* is known as *pipitoria*; the ingredients are the same but the sweet is shaped into thin, flat cakes instead of balls or separate coated elements.

It should be clear from the foregoing that *maiz dulce* does not play a major role in Jaliscan diet. It is essentially a basic ingredient of several confections which are prepared only occasionally, much as we roast peanuts, pop corn, or make taffy. In afternoon and evening, vendors may appear on the streets or in the plazas of the small pueblos, offering homemade *pinole*, *ponteduro*, or *pipitoria*, in company with roasted peanuts, toasted *garbanzos*, *habas*, squash seeds, and similar local delicacies. As far as we know, the commercial aspects of sweet corn are

<sup>6</sup> *Esquite* is prepared from roasting ears which are somewhat old and past their prime. The kernels are cut from the cob and toasted in a clay plate or tray (*comal*). They are then removed to another vessel, sprinkled with salt water, and returned to the hot tray until the moisture has evaporated. They are eaten as a confection.

<sup>7</sup> *Pinole* is prepared from dried, shelled, mature *maiz dulce*. The kernels are toasted in an earthen tray and then ground on the *metate* with *panocha* (known also as *piloncillo*, a coarse brown sugar sold in the form of hard cakes or cones) and *canela* (cinnamon bark or a local substitute therefor). The resulting powder is eaten dry or accompanied by a glass of milk; it does not appeal to an untrained palate, being somewhat reminiscent of licorice powder.

<sup>8</sup> *Ponteduro* is the local equivalent of sugared peanuts or peanut brittle. A syrup of *panocha* and water (sometimes milk) is boiled until it thickens. To it are added the dry, toasted kernels of *maiz dulce*, together with toasted squash (*calabacita*) seeds and roasted peanuts. The mixture is removed from the fire and stirred until it hardens. The *panocha* coats the various elements or, if desired, binds them into a ball. The resultant confection is extremely sweet and because of its hardness is something of a test of dental prowess.



confined to this type of informal vending. In fact, the occurrence of sweet corn in Jalisco is a relatively inconspicuous affair and might well escape the notice of a casual traveler.

## SUMMARY

The relative importance of cultural and genetic data in determining the origins of crop plants is discussed briefly. Their comparative significance is very different for sweet corns and dent corns. The various morphological and cytological features of Jaliscan sweet corns are described and summarized. While generally similar to other Jaliscan maize, they are more uniform as a group and have larger, broader ears. They are widely, although not commonly, grown in Jalisco by country people, chiefly for home use in the form of two special confections, *pinole* and *ponteduro*.

The data suggest that sweet corn is not a recent introduction in Jalisco. When similar studies are available for other areas, it should be possible to discuss authoritatively the origins of North American sweet corns.

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## EXPLANATION OF PLATE

## PLATE 4

Two ears of sweet corn from Unión de Tula, Jalisco; x about 9/10.